REMARKS

By the present Amendment, claims 1-10 are cancelled and claims 11-18 are added to clarify the claims. This leaves claims 11-18 pending in the application, with claims 9 and 19 being independent.

Substitute Specification

The specification is revised to eliminate grammatical and idiomatic errors in the originally presented specification, and to add headings and an Abstract of the disclosure. The number and nature of the changes made in the specification would render it difficult to consider the case and to arrange the papers for printing of copying. Thus, the substitute specification will facilitate processing of the application. The substitute specification includes no "new matter". Pursuant to M.P.E.P. § 608.01(q), voluntarily filed, substitute specifications under these circumstances should normally be accepted. A marked-up copy of the original specification is appended hereto.

Rejections Under 35 U.S.C. § 112

Claim 1 stands rejected under 35 U.S.C. § 112, second paragraph, as being indefinite as to the recitation of "the surfaces". As amended herein, claim 1 provides proper antecedents for all terminology used therein.

Accordingly, the claims are definite and comply with all requirements of 35 U.S.C. § 112.

Rejections Under 35 U.S.C. §§ 102 and 103

Claim 1 covers a process for producing a flat commutator comprising forming a metal carrier with segment support parts and a hub of electrically insulating material coupled to the carrier body. An annular disk is joined in an electrically conductive and strong mechanical manner to the carrier body on its side opposite the hub, with the annular disk being resistive to a reactive environment. The carrier body is divided to separate the segment support parts and to form exposed surfaces of the segment support parts by the separation. The annular disk is divided into annular segments. The exposed surfaces of the segment support parts are coated with an environment resistant coating by currentless deposition carried out from a solution or a suspension.

By forming the method in this manner, the method can be performed economically and will produce a superior product.

Original claims 1-4 stand rejected under 35 U.S.C. § 102 as being anticipated by U.S. Patent No. 5,157,299 to Garlach. The Garlach patent is cited for a method of producing a flat commutator involving providing a hub with insulative material or plastic, joining an annular plate of a carbon disk that is metal coated and that is divided into segment parts and supporting parts, and coating exposed or selected areas of the segments. Additionally, the Garlach patent is cited for allegedly disclosing the cutting of the combination of the annular plate and plastic hub into segments.

The Garlach patent does not anticipate or render obvious the subject matter of claim 11 since it does not disclose or render obvious the forming of exposed surfaces on the segment support parts by the dividing of the carrier body, in combination with the coating of those

exposed surfaces on the carrier body as recited in claim 11. Additionally, the Garlach patent does not anticipate or render obvious a currentless deposition of the coating, and more particularly, does not disclose or render obvious the current deposition of the coating from a solution or a suspension as defined in claim 11.

Relative to the Garlach patent embodiment of Figure 3, as described in column 5, lines 59-62, an air gap 6 penetrates into moldable plastic filling the intermediate clearance between the side surfaces 2' of the segment supporting parts 2. In this manner, the plastic of the hub covers these surfaces, not a coating. Additionally, the surfaces are not provided by dividing the carrier body to separate the segment support parts.

Similarly, as illustrated in Garlach patent Figure 3 and described in column 8, lines 16-23, the moldable plastic compound is between the side surfaces 202' of the carbon segment-supporting parts 202. Thus, the hub material covers the sides of the segment support parts, not a coating.

Further, the lack of any description of a currentless deposition or of a currentless deposition from a solution or a suspension in the Garlach patent prevents the Garlach patent from anticipating or rendering obvious the subject matter of claim 11.

Claims 12-18, being dependent upon claim 11, are also allowable for the above reasons. Moreover, these dependent claims recite additional features further distinguishing them over the cited patents. Specifically, the carbon disk of claim 12, the division of the carrier body after joining with the annular disk of claim 13, the one step division of the carrier body and the annular disk of claim 14, the combination cut by abrasive cutting or sawing of claim 15, the selective coating of only the exposed surfaces of the segment support parts of claim 16, the

coating of tin, silver or chromium of claim 17, and the coating thickness of claim 18, are not anticipated or rendered obvious by the cited patents, particularly within the overall claim combination.

Relative to claims 17 and 18, which correspond to original claims 5 and 6, U.S. Patent No. 6,080,497 to Carey is cited. The Carey patent is cited for applying a coating of tin alloy having a thickness greater than 0.0001 inch (2.5 micrometers) for corrosion protection. In support of this rejection, it is alleged that it would be obvious to provide the Carey coating in the Garlach method. However, the Carey patent does not cure the deficiencies relative to the lack of currentless deposition from a solution or suspension to provide a coating on surfaces exposed by the division of the carrier as required in claim 11.

Accordingly, claims 11-18 are allowable. Prompt and favorable action is solicited.

Respectfully submitted,

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[marked-up version]

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~~PCT/EP00/05333~~

Patent Application

of

ECKHARD KÖNIG

for

A process for producing a flat commutator

~~and a commutator produced using this process~~ — all caps

Field of the Invention

The present invention relates to a process for producing a flat commutator ~~as claimed in the preamble of claim 1~~ and a commutator produced using this process. These commutators can be used especially in electric motors to drive a fuel pump which pumps fuels obtained from renewable raw materials.

Background of the Invention

In the production process ~~known from~~ disclosed in WO 97/03486, a metallic, pot-shaped carrier body ~~which~~ forms segment support parts and is shaped from a copper plate. The copper plate ~~which~~ has been segmented beforehand by grooves and is extruded with a hub formed from an electrically insulating molding compound. ~~Then~~ The carrier body, on its side ~~which~~ forming the contact surface for the carbon-containing annular disk, is then removed to such an extent that the segment support parts are electrically separated from one another by the grooves ~~which are~~ filled with the molding compound. Then, the annular disk is applied and subsequently, according to the segmentation of

the carrier body, divided into segments, the separating slots projecting into the area of the grooves which is filled with the molding compound.

Since in using the known process the carrier body is segmented before the annular disk is applied, ~~it~~ the process requires additional ~~process~~ steps to make grooves in the carrier body and remove the carrier body into the area of the grooves. Moreover, the dividing must take place precisely in the area of the grooves to ensure resistance to a reactive environment.

DE 36 25 959 C2 shows a drum commutator and a process for its production, in which either on a cylinder ~~which is~~ produced by curling a base plate ~~consisting~~ of a parent or base metal, copper, or on a hollow cylindrical tube piece, protective parts are applied by plating with a copper-nickel or silver-nickel alloy, at least on the surfaces which come into contact with the brushes. Furthermore, the parent metal of the commutator segments on its surface is provided with tin plating by electrolytic plating (column 13, lines 16 and 17) to prevent the copper body from being exposed to a fuel, such as gasohol, ~~in order~~ to prevent decomposition of the fuel. A mixture of unleaded gasoline and 10 to 15% ethyl alcohol is defined as gasohol in the patent.

DE 44 35 884 C2 shows a commutator for use in fuel pumps, with bars ~~which are~~ located around the periphery of the commutator and ~~which are~~ in sliding contact with a brush arrangement, of a wear-resistant copper-magnesium alloy, the magnesium portion of the bars ~~being~~ is between 0.05 and 2.00 percent by mass.

In contrast to this invention, JP 58 075440 A does not ~~show~~ disclose a flat commutator, but a drum commutator. Furthermore, this document is directed at the prevention of fuel oxidation ("to prevent the oxidation of gasoline"). To this end, a plate (sheet 8) ~~which is~~ resistant to fuel is connected with the not yet burnished copper plate ~~which~~ forms ing the carrier body.

FR2 330 169 A also ~~shows~~ discloses a drum commutator (cf. Figures 1 to 3) and hence a nongeneric subject. The layer with reference numbers 11a and 11b depicted in Figure 5 of this document is a layer ~~which is~~ produced by oxidation.

US Patent No. 5,175,463 ~~shows~~ discloses a flat commutator ~~whose~~ with segment support parts ~~are~~ separated by radial slots. A compound with low melting point ~~consisting~~ of different metals is used in the connection of the carbon-containing annular disk with the metallic segment support parts.

DE 29 03 029 C2 ~~constitutes~~ represents the proximate state of the art and ~~shows~~ discloses among others a process for producing a flat commutator in which a copper plate with a disk-shaped sheet of silver or silver alloy invulnerable to gasoline is applied, ~~then~~ the copper plate is slotted at regular intervals, ~~and finally~~ The denuded copper parts of the commutator bars are covered with a galvanically applied electroplated layer of silver or tin.

Summary of the Invention [3a]

~~Therefore the~~ Objects of the present invention ~~is to devise~~ are to provide a process for producing a flat commutator which eliminates the disadvantages of the prior art, which in particular is more economical, and which still ensures sufficient resistance of the finished commutator in a reactive environment. In addition, the coating will be relatively thick, especially in undercuts and/or grooves which may be present as a result of dividing the carrier body, and will be as uniform as possible, ~~and in~~ In any case, it will be possible to apply the coating to form a cohesive layer. ~~In addition,~~ The present invention ~~will make it possible to~~ permits use of electric motors for driving a pump for fuels obtained from renewable raw materials.

~~The object is achieved by the process defined in Claim 1 and by the commutator and electric motor defined in the subordinate claims. Special embodiments of the invention are defined in the dependent claims.~~

The surfaces of the metallic segment support parts, which are exposed by dividing, are covered with a coating which is resistant to a reactive or aggressive environment. The resistance relates especially to protection of the carrier body and/or the segment support parts and the connection to the annular disk against breakdown, relates to electrical conductivity with respect to the contact resistance between the commutator contact surface formed by the annular disk and the pertinent segment support part or between it and the commutator brush, and relates

~~DE 29 03 029 C2 shows among others a process for producing a flat~~ commutator in which a copper plate with a disk-shaped sheet of silver or silver alloy invulnerable to gasoline is applied, then slotted at regular intervals, and finally the denuded copper parts of the commutator bars are covered with a galvanically applied electroplated layer of silver or tin.

Therefore the object of the invention is to devise a process for producing a flat commutator which eliminates the disadvantages of the prior art, which in particular is more economical and which still ensures sufficient resistance of the finished commutator in a reactive environment. In addition, the coating will be relatively thick, especially in undercuts and/or grooves which may be present as a result of dividing the carrier body, will be as uniform as possible and in any case it will be possible to apply the coating to form a cohesive layer. In addition, the invention will make it possible to use electric motors for driving a pump for fuels obtained from renewable raw materials.

The object is achieved by the process defined in Claim 1 and by the commutator and electric motor defined in the subordinate claims. Special embodiments of the invention are defined in the dependent claims.

The surfaces of the metallic segment support parts which are exposed by dividing are covered with a coating which is resistant to a reactive or aggressive environment. The resistance relates especially to protection of the carrier body and/or the segment support parts and the connection to the annular disk against breakdown, relates to electrical conductivity with respect to the contact resistance between the commutator contact surface formed by the annular disk and the ~~pertinent segment support part or between it~~ and the commutator brush, and relates

Also,

to the adhesion of the coating on the metallic segment support part. ~~In addition,~~ insulation must be ensured between the segment support parts. The segment support parts essentially consist preferably of copper and have high electrical and conductivity and ductility. The carrier body is produced, for example, from a punched-out copper plate which is then formed into a pot and is extruded with a molding mass ~~which~~ form~~s~~ing the hub. The carbon-containing annular disk in particular is resistant in a reactive environment, for example in a hydrocarbon-containing liquid. The annular disk and/or the carrier body is/are divided preferably by abrasive cutting, sawing or laser working.

The process steps of forming the grooves and removing the carrier body are eliminated by the carrier body being divided into segment support parts after joining to the annular disk.

Production is further simplified by the annular disk and the carrier body being divided in one step. Alternatively, it is possible in a first step to divide the carrier body, ~~which is~~ provided with the hub and formed into a pot, into segment support parts by first slots; Then, the annular disk is applied; ~~and~~ Finally, the annular disk is divided by two slots into annular segments, the second slots preferably being smaller than the first slots and being located within the first slots. The coating of the surfaces of the segment support parts exposed by dividing the carrier body can be done before or after the application of the annular disk. To the extent the coating takes place before applying the annular disk, the applied layer can be used at the same time as a joining layer to the annular disk.

Because coating takes place by deposition, the metallic carrier body can be coated with any material. Both chemical and also physical and mixed deposition

processes can be used, for example deposition from the gaseous phase (Chemical Vapor Deposition, CVD), optionally plasma- or laser-supported, cathode beam atomization (sputtering), vapor deposition, etc. Vossen, Kern (publisher): Thin Film Processes I and II, 1991, surveys possible deposition methods.

Because deposition takes place from a solution or suspension, a large number of commutator elements can be coated in one step, and thus, economically and with good coverage and layer quality. The layer material is ~~in a~~ preferably in an ionic solution or suspension and can be deposited electrolytically (galvanically) or currentlessly on the segment support parts.

Because deposition takes place currentlessly from the solution or suspension, i.e. without applying an external voltage, coverage of the elements even on inaccessible locations, for example in the dividing slots formed by division, is good. The temperature and concentration of the solution or suspension are chosen such that complete coverage with sufficient thickness is ensured in as short a time as possible.

Because coating takes place selectively only on surfaces of the segment support parts, the annular disk and especially the hub are not coated, preventing the detachment of the layer from these locations, for example due to poor adhesion, and the associated problems in later operation of the commutator. The selectivity of deposition can be adjusted by the corresponding choice of the process parameters during deposition, for example the deposition temperature, concentration of the solution or suspension, deposition duration, etc., depending on the material to be deposited and/or the carrier body to be coated.

Because coating takes place with tin, silver~~,~~ or chromium, good coverage and adhesion as well as sufficient resistance especially to fuels obtained from renewable raw materials is also ensured with economical materials. Tin in particular offers good contact properties, and is also advantageous for joining the winding ends to the segment support parts.

Because the layer thickness is between 0.1 and 10 μm, especially between 1 and 3 μm, reliable coating and good adhesion as well as sufficient resistance are guaranteed. These layer thicknesses arise especially in currentless deposition from a solution or suspension after comparatively short deposition intervals and ensure pore-free coverage of the carrier body.

~~Because~~ In a commutator produced using the process of ~~as claimed in~~ the present invention, the hub in the area of the division, especially on the side of the segment support parts facing away from the commutator contact surface and/or the surfaces adjoining the surfaces exposed by the division of the carrier body, also adjoins the carrier body. Thus, reliable coverage of the metallic carrier body is also ensured in this area. This ~~which~~ coverage prevents scouring of the carrier body and the segment support parts in a reactive atmosphere.

Because the hub forms a complete cover of the cylindrical boundary surface of the central hole of the carrier body, the cylindrical inside of the carrier body is also covered relative to the reactive atmosphere. Also, ~~and~~ the resistance of the commutator is further increased.

Because the coating is resistant to the fuel to be pumped, commutators produced using the process of ~~as claimed in~~ the present invention can also be used in fuel

pumps. ~~Here e~~Especially, tin as the coating material has proven resistant to fuels obtained from renewable raw materials, for example alcohol-based fuels or diesel fuels obtained from rapeseed oil.

A

~~Other advantages, features and details of the invention follow from the dependent claims and the following description in which several embodiments are described in particular with reference to the drawings. The features mentioned in the claims and the description are integral to the invention both individually and in any combination.~~

Figure 1 ~~shows a~~ is a block diagram of a production process according to ~~first embodiment of the production process,~~ present invention;

Figure 2 ~~shows a~~ is a block diagram of a production process according to ~~second embodiment of the production process,~~ present invention;

Figure 3 ~~shows~~ is a bottom plan view of a segmented commutator according to the present invention;

Figure 4 ~~shows a~~ is a side elevational view in section taken along line IV-IV through the commutator of Figure 3;

Figure 5 ~~shows a~~ is a partial side elevational view of the commutator of Figure 3 taken from line V-V; and

Figure 6 ~~shows a~~ is a partial side elevational view of a commutator produced using the production process ~~from~~ of Figure 2, ~~a~~ which view ~~which~~ corresponds to that of Figure 5.

Detailed Description of the Invention

Figure 1 shows a first embodiment of the production process of the present invention. A copper plate is punched out of a copper sheet 50 and a pot-shaped carrier body 51 is then formed from it. The bottom surface of the pot ~~therefore~~ forms the contact surface for the annular disk to be applied. The bottom surface is not presegmented. ~~conversely~~ However, the cylindrical jacket surface of the pot has already been segmented by punching-out. Likewise, hook elements for attaching the coil windings and anchor elements which fit into the hub are made by punching-out. The hub is formed by extrusion 52 of the pot-shaped carrier body by means of an electrically insulating molding compound which is temperature-resistant according to the respective requirements.

insert (A) for p. 7

Other objects, advantages and salient features o the present invention will become apparent from th following detailed description, which, taken in con- junction with the annexed drawings, discloses preferre embodiments of the present invention.

Brief Description Of The Drawings

Referring to the drawings which form a part of thi disclosure:

~~Figure 1 is a side elevational view in section of~~ an apparatus for according to a first embodiment of the present inven- tion;

Figure 2 is a top plan view in section of the apparatus taken along line A-A of Figure 1;

Figure 3 is a side elevational view in section of an apparatus according to a second embodiment of the present inven- tion; and

Figure 4 is a side elevational view in section of an apparatus for according to a third embodiment of the present inven- ~~tion.~~

While various embodiments have been chosen to illustrate the invention, it will be understood by those skilled in the art that various changes and modifica- tions can be made therein without departing from the scope of the invention as defined in the appended claims.

insert (B) for p. 11

Optionally the hub and the contact surface of the carrier body can be worked 53, with respect to the hub, Especially, precision machining of the hub hole which holds the shaft of the rotor ~~being~~ is carried out~~, and~~ With respect to the contact surface of the carrier body, planarizing and optionally pretreatment tak~~ing~~e place ~~with respect to~~ for subsequent application 54 of the annular disk.

The annular disk preferably contains carbon or consists completely of sintered carbon which has the morphology and grain composition necessary with respect to electrical conductivity, abrasion resistance and resistance. The inside diameter of the annular disk is ~~thus~~ preferably larger than the diameter of the hole in the hub. ~~Then~~ Dividing 55 of the annular disk and of the carrier body into segments is done, preferably by a single machining process, for example by abrasive cutting or sawing. The cut slot extends through the annular disk and the bottom of the pot-shaped carrier body, and into the molding compound which follows the carrier body and adjoins it. Division yields the separation of the segments of the commutator in electrical terms, i.e., the electrically conductive connections between the segments are cut through. As before, the segments are mechanically joined securely to one another via the molded-on hub.

~~Then~~ Coating 56 of the carrier body takes place with a material resistant to a reactive environment, for example with tin, silver, or chromium in a layer thickness of 0.1 to 10 μm, preferably 1 to 3 μm. Here preferably all exposed surfaces of the carrier body are coated, especially the surfaces of the metallic segment support parts exposed by the division of the carrier body. Coating takes place preferably by currentless deposition from a solution or suspension, i.e., without a voltage being applied from the outside between the carrier body to be coated and the solution or suspension. Before actual coating, chemical and/or mechanical cleaning takes

place, for example in an ultrasonic bath in order to remove impurities and residues on the surface of the segment support parts and to prepare the surface for coating. ~~Then~~ The essentially copper-containing segment support parts can then be pretreated in a reducing atmosphere. The actual coating takes place preferably at a temperature which has been elevated compared to the ambient temperature. In the corresponding solutions or suspensions for example with deposition intervals of less than one hour, layer thicknesses between 1 and 3 μm can be achieved. ~~Here a~~ A plurality of commutator elements can be coated in one process. After coating the commutators are rinsed and dried.

Figure 2 shows a second embodiment of the production process of the present invention. ~~Here, a~~ After extrusion 152 of the carrier body with the formation of a hub, the carrier body is divided into segment support parts 155A. Then, as described above, coating 156 of the segment support parts is carried out. Alternatively, coating can also take place galvanically or electrolytically, for example with silver in a layer thickness of roughly 5 μm. ~~Then~~ The annular disk is then applied 154 and then divided into annular segments 155B. The cut slots in the annular disk are preferably narrower or equally wide compared to the cut slots in the carrier body; in any case located within the annular disk. Alternatively or in addition to coating 156 of the segment support parts immediately after division 155A of the carrier body, the segment support parts can also be coated as described above only after dividing 155B the annular disk into annular segments.

Figure 3 shows a plan view of the segmented annular disk of a commutator 1 produced using the process ~~as claimed in~~ of the present invention. ~~and~~ Figure 4 shows section IV-IV through the commutator 1 of Figure 3.

The annular disk is divided into eight annular segments 2, likewise, ~~again~~ the carrier body is divided into eight segment support parts 4. A hub 6 formed by extrusion is molded onto the segment support parts 4 of the carrier body and forms a central hole 6a for holding the shaft (not shown) of the rotor of a motor or generator. The segment support parts 4 on their outer peripheral surface 4a have a hook 4b for electrical connection of a rotor winding. In addition, the segment support parts 4 each have at least one anchor element 4c for fixed connection to the hub 6. The outer peripheral surface 4a corresponds in its diameter to the outer peripheral surface 2a of the annular segments 2 formed from the annular disk. The diameter of the inner peripheral surface 2d of the annular segments 2 corresponds essentially to the inner peripheral surface 4d of the segment support parts 4 or is slightly larger.

The joining layer and especially the solder layer 10 between the segment support part 4 and the annular segment 2 is, for example, 50 μm thick. When the annular disk and the carrier body are divided, cut slots 12 are formed which project into the area of the hub 6. The surfaces 14 of the essentially copper segment support parts 4 which are exposed by dividing the carrier body are covered with a coating which is resistant to a reactive environment. Preferably, the outer peripheral surface 4a and the hooks 4b of the segment support parts 4 are also coated. This enables better joining of the segment support parts to the rotor windings, especially easier contact bonding of the segment support parts over the outer peripheral surface 4a when welding the winding ends to the hooks 4b. Conversely, preferably neither the flat surfaces 2b which are used as the brush contact faces nor the surfaces 2c of the annular disk which have been exposed by dividing are coated. The joining layer 10 between the segment support parts 4 and the annular segments

2 is thus coated both on its surfaces 10b which are exposed by dividing and also on its inner and outer peripheral surface 10a.

The cut slot shown enlarged in Figure 5 compared to Figure 4 was produced by abrasive grinding or sawing of the combination ~~consisting~~ of the hub 6, the carrier body which forms the segment support parts 4, and the annular disk which forms the annular segments 2, in one process. The slot is typically a few tenths of a millimeter wide and a few millimeters deep. In particular, by coating using currentless deposition from a preferably tin-containing solution or suspension, a relatively resistant, thick and dense selective coating of the surfaces 14 of the segment support parts 4 exposed by division and optionally of the joining layer 10 can be achieved.

Figure 6 shows a view of a commutator produced using the alternative production process from Figure 2, a view which corresponds to Figure 5. ~~Here first of all~~ The carrier body was initially divided into segment support parts 104 with a first, wider slot 112a~~,~~ ~~then~~ the annular disk is then applied by means of the joining layer 110. ~~and~~ Then the annular disk is divided into annular segments 102 by a second, narrower slot 112b ~~which is~~ aligned ~~to~~ with the first slot. The coating (not shown) of the surfaces 114 of the segment support parts 104 exposed by dividing and optionally that of the exposed surface 110b of the joining layer 110 can take place either before or after application of the annular disk. Alternatively, the joining layer 110 does not ~~cannot~~ end flush with the annular segments 102, but ends flush with the segment support parts 104.

(B) →

What is claimed is:

Claims

1. A process for producing a flat commutator (1) in which a metallic carrier body which forms segment support parts (4; 104)

- is provided (52; 152) with a hub (6) which is formed from an electrically insulating material,
- is joined in an electrically conductive manner and mechanically strong to an annular disk (54; 154) which is resistant to a reactive environment,
- is divided (55;155A) into segment support parts (4; 104),
- the annular disk is divided (55; 155B) into annular segments (2; 102),
- the surfaces of the metallic segment support parts exposed by the division of the carrier body are coated with a coating which is resistant to the environment,

characterized in that

- coating takes place by currentless deposition.

2. The process as claimed in Claim 1, wherein deposition takes place from a solution or suspension.

3. The process as claimed in Claim 1 or 2, wherein the annular disk (54; 154) contains carbon.

4. The process as claimed in one of Claims 1 to 3, wherein the carrier body

is divided into segment support parts (4; 104) after joining to the annular disk, especially wherein the dividing of the annular disk and the dividing of the carrier body take place in one step, preferably by abrasive cutting or sawing of the combination consisting of the carrier body and the annular disk.

5. The process as claimed in one of Claims 1 to 4, wherein coating takes place selectively only on the surfaces of the segment support parts (4; 104).

6. The process as claimed in one of Claims 1 to 5, wherein coating takes place with tin, silver or chromium.

7. The process as claimed in one of Claims 1 to 6, wherein the layer thickness is between 0.1 and 10 μm.

8. A commutator produced using a process as claimed in one of Claims 1 to 7, wherein the hub (6) in the area of the division adjoins the carrier body.

9. A commutator as claimed in Claim 8, wherein the hub (6) forms a complete covering of a cylindrical boundary surface of a central hole (6a) of the carrier body for holding the shaft of a rotor of a motor or generator.

10. An electric motor for driving a fuel pump with a commutator produced using a process as claimed in one of Claims 1 to 7, wherein the coating

Claims

1. A process for producing a flat commutator (1) in which a metallic carrier body which forms segment support parts (4; 104)
   - is provided (52; 152) with a hub (6) which is formed from an electrically insulating material,
   - is joined in an electrically conductive manner and mechanically strong to an annular disk (54; 154) which is resistant to a reactive environment,
   - is divided (55; 155A) into segment support parts (4; 104),
   - the annular disk is divided (55; 155B) into annular segments (2; 102),
   - the surfaces (14; 114) of the metallic segment support parts (4;104) exposed by the division of the carrier body are coated with a coating which is resistant to the environment,

   characterized in that
   - the coating of the surfaces (14; 114) of the metallic segment support parts (4; 104) exposed by the division of the carrier body takes place by currentless deposition, and
   - the currentless deposition is carried out from a solution or suspension.

2. The process as claimed in Claim 1, wherein the annular disk (54; 154) contains carbon.

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3. The process as claimed in one of Claims 1 to 2, wherein the carrier body is divided into segment support parts (4; 104) after joining to the annular disk (54; 154), especially wherein the dividing of the annular disk (54; 154) and the dividing of the carrier body take place in one step, preferably by abrasive cutting or sawing of the combination consisting of the carrier body and the annular disk (54; 154).

13-15

4. The process as claimed in one of Claims 1 to 3, wherein coating takes place selectively only on the surfaces (14; 114) of the segment support parts (4; 104).

16

5. The process as claimed in one of Claims 1 to 4, wherein coating takes place with tin, silver or chromium.

17

6. The process as claimed in one of Claims 1 to 5, wherein the layer thickness is between 0.1 and 10 μm.

7. A commutator (1) with a metallic carrier body which forms segment support parts (4; 104), which is provided with a hub (6) which is formed from an electrically insulating material, and is joined in an electrically conductive manner and mechanically strong to an annular disk (54; 154) which is resistant to a reactive environment, with the carrier body being divided in segment support parts (4; 104) and the annular disk (54; 154) being divided in annular segments (2; 102), and the surfaces (14; 114) of the metallic segment support parts (4; 104) exposed by the division of the carrier body being coated with a coating which is resistant to the

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[Continued on the next page]

~~(54) Title:~~ METHOD FOR PRODUCING A FLAT COMMUTATOR ~~AND A COMMUTATOR PRODUCED ACCORDING TO THIS METHOD~~

Abstract of the Disclosure

~~(57) Abstract: The invention relates to~~ A method for producing a flat commutator ~~(1) in which~~ includes forming a metallic supporting body ~~which forms~~ with segment supporting parts ~~(4; 104) is provided (52; 152) with~~ and forming a hub ~~(6) made~~ of an electrically insulating material. ~~Said~~ the supporting body is connected in an electrically conductive and mechanically fixed manner to an annular disc ~~(54; 154) which is~~ resistant in a reaction-promoting environment. The supporting body is divided ~~(55; 155A)~~ into segment supporting parts ~~(4; 104)~~. The annular disc is divided ~~(55; 155B)~~ into annular segments ~~(2; 102)~~. The surfaces of the metallic segment supporting parts which are bare as a result of the division of the supporting body are coated with a coating that is resistant to the environment. ~~The inventive method is characterized in that~~ the coating is carried out by currentless deposition. The ~~invention also relates to a~~ commutator produced according to this method ~~in which~~ the hub ~~is~~ has adjacent to the supporting body in the vicinity of the division.

~~[Continued on the next page]~~

[Marked-up Version]

3. The process as claimed in ~~one o~~f Claim~~s~~ 1 ~~to 2,~~ wherein the carrier body is divided into segment support parts (4; 104) after joining to the annular disk (54; 154), especially wherein the dividing of the annular disk (54; 154) and the dividing of the carrier body take place in one step, preferably by abrasive cutting or sawing of the combination consisting of the carrier body and the annular disk (54; 154).

4. The process as claimed in ~~one of~~ Claim~~s~~ 1 ~~to 3,~~ wherein coating takes place selectively only on the surfaces (14; 114) of the segment support parts (4; 104).

5. The process as claimed in ~~one of~~ Claim~~s~~ 1 ~~to 4,~~ wherein coating takes place with tin, silver or chromium.

6. The process as claimed in ~~one of~~ Claim~~s~~ 1 ~~to 5,~~ wherein the layer thickness is between 0.1 and 10 μm.

7. A commutator (1) with a metallic carrier body which forms segment support parts (4; 104), which is provided with a hub (6) which is formed from an electrically insulating material, and is joined in an electrically conductive manner and mechanically strong to an annular disk (54; 154) which is resistant to a reactive environment, with the carrier body being divided in segment support parts (4; 104) and the annular disk (54; 154) being divided in annular segments (2; 102), and the surfaces (14; 114) of the metallic segment support parts (4; 104) exposed by the division of the carrier body being coated with a coating which is resistant to the

environment, wherein the coating by currentless deposition from a solution or suspension is applied to the surfaces (14; 114) of the metallic segment support parts (4; 104) exposed by the division of the carrier ody and the hub (6) in the area of the division adjoins the carrier body.

8. A commutator (1) as claimed in Claim 7, wherein the hub (6) forms a complete covering of a cylindrical boundary surface of a central hole (6a) of the carrier body for holding the shaft of a rotor of a motor or generator.

9. A flat commutator (1) as claimed in Claims 7 ~~or 8,~~ wherein the coating deposited currentlessly and preferably from a solution or suspension is resistant to a fuel obtained from renewable raw materials.

10. An electrical motor for driving a fuel pump with a flat commutator (1) as claimed in ~~one of~~ Claim~~s~~ 7 ~~to 9.~~

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environment, wherein the coating by currentless deposition from a solution or suspension is applied to the surfaces (14; 114) of the metallic segment support parts (4; 104) exposed by the division of the carrier ody and the hub (6) in the area of the division adjoins the carrier body.

8. A commutator (1) as claimed in Claim 7, wherein the hub (6) forms a complete covering of a cylindrical boundary surface of a central hole (6a) of the carrier body for holding the shaft of a rotor of a motor or generator.

9. A flat commutator (1) as claimed in Claims 7 or 8, wherein the coating deposited currentlessly and preferably from a solution or suspension is resistant to a fuel obtained from renewable raw materials.

10. An electrical motor for driving a fuel pump with a flat commutator (1) as claimed in one of Claims 7 to 9.

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